

THE PROBLEMS OF AN IRRIGATION FARMER.

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INTRODUCTION.

Our rapidly increasing population is undergoing a widespread readjustment. The continued high price of foodstuffs is intensifying interest in agricultural production, with a consequent demand for additional producing areas. The stimulus of high prices has been felt in the East as well as in the West, but the West, with its larger resources of undeveloped land and water, its more salubrious climate, and its more diversified agricultural possibilities, has attracted more attention among home seekers and those who would gain an agricultural livelihood. The Western States are therefore entering upon an era of extraordinary agricultural development.

Since much of this western country is arid, its agricultural development involves irrigation. Irrigation is an art until recently but little practiced in American agriculture or, indeed, in the European countries, whence our agricultural people and practices have come. As a result, the agricultural development of the West presents many problems and difficulties new alike to the individual and to the race. Of these problems, some are immediate and acute, while others are more remote and unappreciated though no less vital to the ultimate welfare of the West and the people who inhabit it.

The Federal Government is taking an active part in the irrigation development of the western United States under the authority of the reclamation act of June 17, 1902, which provides for the use of money derived from the sale of public lands in the construction of irrigation works. Such works have been started on some thirty projects and a few have been completed, and the lands are now being taken up by settlers.

In connection with this work of the Reclamation Service, the Department of Agriculture has undertaken an investigation of the agricultural problems on several of these new projects. The investigations at present under way deal chiefly with crops and crop problems, tillage methods, crop rotations, and the establishment of new

crop industries. It is in connection with these investigations that the problems here considered have been brought out.

In the past, and even recently, large profits have been made from crop production on irrigated lands. In the majority of these cases there have been unusual combinations of circumstances, which are likely to occur in the future with increasing rarity. Irrigation tends to insure but one factor—water supply—in the farmer's complicated equation. A regular water supply by no means insures safety in other directions. It does not insure protection from hail, frost, cyclones, plant disease, or insect pests. Nor does it guarantee high prices for crops or a cheap and adequate supply of labor. The great majority of home seekers on irrigated lands must be content with a fair living instead of immediate wealth.

IRRIGATION A NEW PROBLEM IN AMERICA.

Though irrigation was practiced by the prehistoric inhabitants of western America long before the European discovery of the continent, its adoption by European settlers dates back little more than half a century. In fact, no considerable progress in irrigation had been made prior to the present generation of western farmers. Thus, while the experience of these farmers may serve as a guide and a warning to the beginner at the present day, the larger experience gained in other lands must aid in the solution of many problems that are being encountered.

Ancient remains show that there flourished in western North America in pre-Columbian times an irrigated agriculture of considerable extent and importance. It is most unfortunate that no history of this earlier period of irrigation has been preserved, so that we might draw upon the experience of those earlier people for guidance in taking up anew the task of conquering the desert. Indistinct ditch lines and vague traditions are all that remain to tell us what lands and what waters they found good and what bad. It remains for us to work out for ourselves the problems of soils, crops, alkali, and drainage, as well as the no less essential problems of cooperation, farm implements, markets, and transportation.

CAPITAL AND EXPERIENCE ESSENTIAL.

Farming either with or without irrigation is an extremely complicated art which looks much simpler than it really is. Irrigation farming has often in the past yielded rich returns, but it is not to be expected that every effort will duplicate the results of the most famed localities. The present outlook does not appear less promising

than the past, but the past also shows that bright prospects may be overemphasized by those who have irrigated lands to sell.

Western irrigated lands are being settled largely by people from the East, and a surprisingly large number of these settlers come from cities and towns and bring with them little capital, either in money or in agricultural experience. To the true pioneer a lack of experience or money is not an insurmountable obstacle. In time he will get at least the experience. True pioneers may come from towns and cities as well as from the country. Unfortunately, however, many people who have failed to make a livelihood in eastern cities are encouraged by extravagant advertisements to believe that certain prosperity awaits them on irrigated farms in the West, that failure is impossible, and that no experience and but little money is required for a start. Yet it would be incorrect to say that a man can not start an irrigated farm and succeed without experience and even without money. This has been done and can doubtless be done again; but such success is won only at the cost of heroic perseverance and through the endurance of hardships and privations that test the courage of the strongest. For every farmer who succeeds under these circumstances many will fail. Nor does failure result alone from lack of money or of agricultural experience. Even farmers who move from the East or the Middle West to western irrigated lands have much to learn, and not infrequently they are slower to appreciate this fact than their brothers from the city, who have an earlier realization of their own ignorance and begin at once the accumulation of local knowledge.

Any settler in a new region may save himself many costly errors by a preliminary study of local agricultural practices. It is often true that local practice is not the best, and the newcomer may himself in time be instrumental in improving it, but it is the part of wisdom to approach this reformation cautiously.

DIVERSITIES OF IRRIGATED LANDS.

Western irrigated lands represent a diversity of conditions not exceeded in all the rest of agricultural America. They include the hot, dry valleys of the Southwest, where rain and frost are almost equally unknown, as well as the high, cool valleys in the mountains, where winter snows lie deep and summer frosts are not infrequent. Some of the irrigated lands are to be found on the extreme Pacific coast, where the climate of winter and summer differs chiefly in the amount of rainfall rather than in the change of temperature, and on the eastern slope of the Rocky Mountains, where the annual ex-

tremes of temperature are as great as anywhere in the country. From the groves of oranges and date palms to the mountain meadows, with their single crop of hay each season, one may find irrigation practiced. Each locality has its special advantages and its peculiar problems, and only the most general problems are shared by all irrigated regions. It is the purpose here to call attention to some of the general problems and to point out some of the ways in which they are being solved.

For instance, the questions of the best method of clearing and leveling land for irrigation, of building distributing ditches, and of the first crops to plant are local problems to be determined for each new region. There are many different methods of leveling land and getting water over it. Almost every region has its peculiar system, and the newcomer who would save his money and avoid serious mistakes will follow the system generally in use until he has established himself and learned the local conditions.

SELECTING AND STARTING AN IRRIGATED FARM.

The selection of an irrigated farm is not a matter that may be safely delegated; nor is it a matter that should be undertaken carelessly or hurriedly. One who proposes to spend his life on a piece of land and to leave it as a heritage to his children should take plenty of time and, if necessary, spend a little money on a preliminary investigation. There are many important factors to be kept in mind. The available lands in any new region often differ greatly in immediate, if not in ultimate, value. It costs much more to prepare some lands for irrigation, and some will yield returns much more quickly than others. These and many other factors should be kept in mind when the farm is selected. Above all things, it is unprofitable to buy a farm through correspondence without seeing it and then to employ some one else to put it into crops. This custom of buying a home ready made and on the installment plan has little to recommend it, so far as the buyer is concerned.

The development of a farm under irrigation is almost always a slower and more expensive undertaking than where irrigation is not required. The land must be leveled and ditches constructed in addition to all the work required in establishing a new farm in unirrigated regions. The cost of such work varies greatly in different localities. Where it is too expensive to be done all at once, the producing area of the farm is, of course, limited accordingly. Then, too, desert land is not always immediately productive when water is first applied. It sometimes takes a season or two, or even longer, to get into condition for the profitable growing of crops land that will

eventually become productive. In regions that are isolated and at long distances from the larger markets, so that only the higher priced fruit and dairy products will bear the cost of shipment, it is sometimes several years before new farms begin to bring in any considerable cash returns. It is therefore a wise precaution to retain enough capital to carry one through at least the first season as an insurance against total crop failure.

Probably no other single factor has caused more failures on irrigated farms than enforced abandonment through the lack of means or perseverance to stay on the farm through the first years until returns begin to come in. There are relatively few locations where the soil is immediately productive and where there is a market for such produce as can be grown the first year or so.

CHOOSING CROPS AND CROP ROTATIONS.

In the development of a new agricultural region it is seldom possible to predict what crops will prove the most profitable. In almost any region the farmer is forced to choose from a large number of possible crops the ones best suited to his needs and markets. In any new region there is a tendency to specialize on one or at most a very few crops, and in the irrigated regions, particularly, this tendency toward a single crop is very pronounced. The use of crop rotations and the intelligent diversification of crops on the farm are never conspicuous features of a newly opened agricultural region. Grain and alfalfa are the pioneer irrigated crops, and these are usually followed by attempts to grow vegetables or orchard fruits extensively. Sometimes, indeed, new land is put into vegetables, orchard fruits, or sugar beets in an attempt to secure early cash returns. There are altogether too few irrigated regions in this country at the present time where any attempt is made toward the use of crop rotations with a view to keeping up the productive capacity of the soil. There appears to be a widespread impression that the fertility of irrigated lands is inexhaustible; that land may be used for a single crop or for a series of intertilled crops for an indefinite period. The experience of generations of farmers in humid regions is disregarded. New land is often planted to orchard fruits, to be continuously intertilled from the first and with the expectation of continuing this clean culture and fruit production indefinitely. In fact, whole regions are sometimes opened to colonists, with the expectation that each farm will immediately become and will remain exclusively devoted to some type of orchard fruits, with its consequent clean cultivation and without any means of maintaining the absolutely essential supply of organic matter.

One of the most serious problems on American irrigated lands is that of organic-matter supply. As long as these lands remain relatively cheap and the farm units are not too small, a rotation of crops, including alfalfa, can be used. But alfalfa is far from being an ideal rotation crop for many regions, and the temptation is strong, once a good stand is secured, to let it remain as a permanent crop outside the rotation. For orchards and vineyards we lack a suitable assortment of annual leguminous crops to use for green manure. These problems of crop rotation and of the supply of organic matter are usually problems of the older irrigated regions, though in some instances the desert lands are naturally so poorly supplied with organic matter that this question quickly becomes acute.

In some of the older and more highly developed irrigated fruit regions farmers are now confronted with this problem of plant nutrition. This is particularly true in those sections where a scanty water supply requires continuous clean tillage for moisture-conservation purposes. This clean tillage has not only prevented the addition of any new supply of organic matter, but has made conditions in the highest degree favorable for the complete disintegration and conversion of the supply originally contained in the soil. The importance of organic matter can scarcely be overestimated. Its depletion must be avoided if crop production is to be maintained. It therefore becomes a problem of the first importance to so plan the crop rotations on the farm and to so arrange the orchard plantings as to provide for the use at frequent intervals of such crops as will increase the supply of organic matter in the soil.

TILLAGE AND WATER ECONOMY.

The lavish use of water is the direct cause of many serious irrigation difficulties. In fact, some of the most profitable and highly developed irrigation farming in this country owes its existence and prosperity to a scarcity of water supply. As long as a farmer has an abundance of water he almost invariably yields to the temptation to use it freely, even though he gets no increase in returns as a result. Where crop production is dependent on rainfall, and particularly where the rainfall is barely sufficient, farmers soon learn the value of careful and thorough tillage both in preparing the land for a crop and later whenever intertillage is possible. But the irrigation farmer with an adequate water supply is slow to appreciate the fact that thorough tillage methods abundantly repay their cost. In new regions, particularly, the tendency to neglect tillage is pronounced. In new irrigation regions weeds are usually not abundant, and one of the most

obvious reasons for good tillage is lacking. The fact remains, however, that in irrigation farming good tillage pays, whether the water supply is abundant or scanty.

Excessive irrigation leaches the soil or fills it with water to the exclusion of air and consequently interferes with the activities of the micro-organisms upon which crop plants depend for their food supply. Good tillage produces the opposite result. A wet soil remains cold, while a well-tilled soil warms up quickly and favors plant growth. It is not sufficient to keep down the weeds by cultivation. With intertilled crops a cultivation should follow every irrigation, and the land should be irrigated no more frequently than is absolutely necessary. This much is true where there is abundant irrigation water. Where the irrigation water is scanty there is the added advantage that it can be made vastly more effective if supplemented by tillage. As a people we have much to learn in the way of water economy. With proper use the irrigation supply of the great majority of our irrigation districts could be used for much larger areas than it covers at present.

A more judicious use of the supply would also in many cases result in larger yields to the acre and would permit the use of large areas now kept too wet for crop production through the excessive use of water on adjacent land.

UNDERGROUND WATERS AND ALKALI.

One of the most striking features in the history of irrigation in the Old World is the ruin of irrigation enterprises caused by the rise of underground waters and of alkali. Both in theory and in practice these phenomena are closely associated. Arid lands almost universally contain large quantities of soluble salts, because these salts—the products of rock disintegration and soil formation—are not leached out by rain. The more common salts thus formed are sodium chlorid, sodium sulphate, and sodium carbonate, and though only the last is really an alkaline salt, the popular term “alkali” is applied to whatever salts occur in the soil water in sufficient quantities to check or prevent plant growth. Excessive irrigation in time fills the soil with water, in which these salts are dissolved, and the evaporation of the water from the ground brings the salts up and leaves them at or near the surface in constantly increasing quantities. Unless natural drainage courses are present or artificial ones are created the inevitable result of excessive irrigation is that the land becomes too wet or too alkaline for the growth of crop plants.

This problem of underground waters should be constantly in mind, not only in the selection of an irrigated farm but also in its manage-

ment. It does not suffice that a farmer himself use irrigation water judiciously, for the reckless use of water on adjacent higher land may ruin a farm completely. It is true that either underground waters or alkali alone may cause trouble in some cases, but they occur most frequently together and both yield to the same remedy, which is adequate drainage.

There are a few irrigated regions in the western United States where a high underground water table is not a menace to crop production and where subirrigation is practiced, but in these regions there are unusual local conditions. In the great majority of cases where the underground water table is so close to the surface that capillary action can bring water up from the lower depths of the soil to be evaporated at the surface, serious trouble with alkali is almost certain to follow. There are a few localities where alkali is a serious problem where apparently there is no well-defined underground water table. In such cases the soil is generally so heavy as to be nearly, or quite, impervious to any leaching action of water. Where this is the case the farmer is confronted with an extremely difficult problem which involves special treatment of the soil, either by proper tillage methods or by the addition of manure or gypsum, in order to overcome the imperviousness. The one certain remedy for alkali difficulties is drainage. Wherever it is possible to bring about a progressive downward or lateral movement of water through the soil, alkali ceases to be a problem. Where this is not practicable and where alkali occurs in relatively small quantities, a temporary postponement can be obtained by the sparing use of irrigation water to wash the salts down into the soil and by thorough tillage after irrigation, which will tend to prevent the return of the salts to the surface through the capillary movement of the water. In general, however, it seems certain that a downward movement of water through the soil must be maintained either by natural or artificial means before an irrigation enterprise can be regarded as secure from injury by alkali.

In the selection of new land for irrigation farming the possibilities of later troubles from alkali and high ground water should be constantly kept in mind. Where desert land has never been irrigated there is very often no superficial indication of alkali, and to the inexperienced observer it is hard to predict what irrigation will develop. To one well acquainted with the region this is much less difficult. The native vegetation, if properly interpreted, is a very satisfactory indicator of the presence or absence of injurious quantities of salts in the soil. In different regions there are different species or groups of species that are commonly regarded as the most valuable indi-

cators. In the lower Colorado River Valley, for instance, the presence of the creosote bush (*Covillea tridentata*) is regarded as an indicator that the land is fairly free from alkali. In the Great Basin the presence of the greasewood (*Sarcobatus vermiculatus*) indicates that alkali troubles may be expected.

In prospecting a new region it is always desirable to learn the local opinions regarding indicator plants, to observe the depth and character of water in wells or drainage channels, and to note the general topography in relation to any piece of land under consideration. In any section with pronounced topographic features this last is very important. There are valleys in the West where irrigation has been used first on the valley floor, then on a bench just above, and later on still higher benches, with the result that the valley floor and the lower benches have been swamped by the salt-bearing seepage water from above. Damage of this sort can be prevented or remedied by proper drainage measures, but until this can be worked out and put into effect the lower land remains practically worthless.

Much remains to be learned concerning the movement of underground water and its relation to the accumulation and removal of alkali. This problem is of direct and immediate importance, not only to the majority of individual irrigation farmers but to those who are responsible for the engineering features of irrigation enterprises.

COMMUNITY LIFE AND COOPERATION.

Irrigation farming ordinarily involves much more in the way of community relationships and responsibilities than exist elsewhere in country life. Land holdings are usually smaller, bringing the farm homes closer together. Land values are higher, permitting higher taxation, with its consequent better roads and better schools.

Irrigation communities are, as a rule, isolated from each other and often separated by long distances from other settlements. Their existence depends upon the water supply which the settlers share in common. A larger proportion of their problems are community problems than is the case where settlement is more sparse and the settled areas are less sharply defined. The prosperity of the individual depends to an unusual degree upon that of the community. In other words, the members of a community find it in the long run to their advantage to deal with problems from the community standpoint rather than from that of the individual. The general acceptance of this point of view is one of the important features of irrigation farm life in the United States. The essential elements of community life are not always easily learned or consistently practiced. But with the inducements all in favor of cooperation it soon comes to be generally accepted as a part of the environment.

The cooperative features of life in irrigation communities are many and varied. Beginning with ditch construction and maintenance they extend to the purchase of supplies, associations for marketing produce, various manufacturing enterprises, such as butter and beet-sugar factories, and into the social life in the way of various mutual-improvement associations. These activities and responsibilities are among the distinct advantages of irrigation farming, yet their proper development requires much in the way of individual self-sacrifice.

The tendency toward intensive and specialized crop production in irrigated communities renders some practical problems more acute than in regions that are sparsely settled and have a more diversified agriculture. Among these are problems of insect pests and plant diseases. In communities where some one crop is extensively grown there is always danger that some insect pest or plant disease may find conditions that favor a rapid spread, with large resulting injury. Where an irrigation community is isolated there are better opportunities of avoiding the danger of such invasions, particularly in diseases of orchard fruits, by an effective system of inspection of all nursery stock brought in.

Much of the prosperity of western irrigation enterprises is the result of cooperative work in marketing products. This cooperation has not been limited merely to economy of effort and the avoidance of duplication; it has extended to the task of maintaining a high standard of quality by rejecting all inferior produce, thus securing a well-established reputation for the products. The establishment of such a standard is often difficult to bring about in a new community, for it means the rejection of produce when this action will bring real hardship to many individuals and arouse much dissatisfaction and complaint.

MARKETS AND TRANSPORTATION.

With few exceptions our irrigated lands are situated far from any considerable markets, with the result that revenue-producing crops must be sufficiently high priced and concentrated to bear a relatively large transportation charge. In a new irrigation community the problem of producing crops that can be shipped long distances profitably is always a difficult one. Most of the crops that are naturally grown first on a farm, such as the grain and forage crops, are too low priced to bear large transportation charges. The perishable truck crops, such as cantaloupes and tomatoes, involve large risks, because of uncertain market conditions. It remains to depend for revenue on such crops as potatoes and onions, which are less perishable.

As the community grows older, with more of a nonagricultural local population, the local market becomes something of a factor in

the farm revenue, but at first, when nearly everyone is producing what he uses, or at least using what he produces, the local market must be left out of account and the estimates of revenue must be based on what can profitably be shipped to outside markets.

In view of these facts, it is a wise precaution to plan and equip a new irrigation farm in a new region with a view to producing as much as possible of the food required. This involves the keeping of live stock and poultry and the raising of plenty of vegetables in addition to the grain and forage crops. After an irrigation district has been developed, it is safer to specialize in crop production, if this proves desirable. At first the aim should be to produce the supplies needed for home consumption, in order to cut down living expenses until a market is assured from which a revenue can be derived. Markets for perishable fruits and vegetables are slow to develop and are often uncertain, while dairy and poultry products find a ready sale and will bear long transportation charges.

CONCLUSION.

The problems of irrigation farming have been here emphasized not with the purpose of deterring anyone from venturing westward to make a home on irrigated lands, but rather as a warning that irrigation farming, like any other farming, is a complicated enterprise, with small reward for the inept and the shiftless, though offering the prospect of at least a comfortable home and an independent livelihood for the intelligent and the industrious. Irrigation farming is becoming an increasingly important phase of American agriculture. It is being used not only in the development of the arid West but also in the more humid parts of the country where the requirements of intensive farming exceed the available supply of rainfall or demand water at seasons when the rainfall is inadequate. There is every reason for believing that as the benefits of irrigation become more generally understood it will be much more extensively practiced than at present. Much irrigable land and much available irrigation water still remain unused.

As would be naturally expected, the earlier irrigation enterprises included the simpler engineering problems as well as the better irrigable lands. As the limit of irrigation possibilities is approached, the engineering and agricultural problems become increasingly difficult. Also, as the present irrigation enterprises become older it is to be expected that new and more complicated problems will arise. These inferences appear to justify the conclusion that the ultimate success of irrigation farming in this country will depend largely upon the ability of experimenters and investigators to solve and overcome these problems and upon the extent to which the farmers themselves use the precautions or apply the remedies suggested.

The rapid extension of the acreage of irrigated land will call many colonists who are unfamiliar with irrigation methods and difficulties and who are in some cases unprepared to endure the vicissitudes of pioneer life. It would be too much to expect that this rapid colonization should be accomplished without a considerable number of individual failures. The most that can be hoped is that the great majority of the pioneers will succeed and by their success show the way to overcome the earlier problems, and that through this first success they may gather the courage to meet and overcome the later difficulties that will follow as irrigation becomes an older institution.